Monthly Progress Report for April 1962

RESEARCH AND DEVELOPMENT OF HIGH EFFICIENCY LIGHTWEIGHT SOLAR CONCENTRATORS

Prepared for

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1. ACCOMPLISHMENTS

This report covers the period from 1 April 1962 through 30 April 1962 and is submitted in accordance with the provisions of the referenced contract. During this reporting period, which covers the sixth month of effort on the program, progress was made in the following areas of activity.

1.1 Concentrator Design

With the exception of the specific design requirements for the preliminary models of 5-foot diameter concentrators which are being produced under this program, general design efforts remain temporarily suspended. They will be continued when further and more conclusive results are obtained from the small scale structural studies and the current development of 5-foot diameter mirrors.

1.2 Small Scale Studies of Support Structures

Small scale studies were continued during this period. Problems associated with leaking of the electrolyte between the reflective face and the glass master around the rim of mirror during secondary plating operations have been overcome. Maximum usable reflective area with minimum edge roll or other undesirable effects has been achieved using the rolled edge technique rather than the chain encapsulation technique.

1.3 Five-Foot Diameter Concentrator Development

1.3.1 Special Equipment

The rotational assembly has been assembled and checked out and is now complete with the exception of the commutator and power contact assembly. Design of this unit was modified to improve ease of assembly and to minimize space requirements. Fabrication of the contactor and master attachment fixtures is scheduled to be complete by 1 June 1962.

1.3.2 Five-Foot Experimental Plating

An experimental rolled edge reflective skin has been electroformed using the stationary holding fixture previously employed for fabrication of concentrators of this size. Objectives of the test fabrication were to work out details of tooling, mandrels, and other special equipment required to form the rolled edge on the five-foot diameter master and to evaluate problems which might be encountered on this scale. Cathode power transmission was accomplished by means of a clamp ring attached to the outer rim of the mirror master. Power was fed to the clamp ring by means of a number of uniformly spaced cathode wires. The edge roll was produced by the use of a wax master extension which was uniformly machined to contour by means of a swing arm positioned in the center of the mirror master. No attempt was made during this initial plating to maintain an exact balance or uniformity of skin thickness since this can be achieved more readily on future parts when rotational techniques are used.

Fabrication has been completed on two of the first three electroformed torus brackets which will be incorporated in the first of the five-foot nickel concentrators. These torus brackets incorporate a lightweight, threaded, stainless steel sleeve which is encapsulated or "grown-in" the torus transition section during formation. These threaded sleeves serve as points of attachment for testing and mounting of the finished concentrator. The positioning jig and rotational fixture for electroforming of the torus has been modified to accommodate the new design having an outside diameter of sixty inches. Fabrication will continue on the remaining required torus bracket section for both the nickel and copper concentrators. It is expected that at least one all electroformed nickel torus will be completed by the end of the next reporting period.

The first experimental five-foot diameter concentrators will be rigidized using aluminum tube tori to eliminate the large amount of time associated with fabrication of all electroformed tori. However, all other structural components, transition sections, and points of attachment will be electroformed.

2. PLATING STUDIES

Testing and analyses are continuing on all of the plating baths. A large number of test specimens have been produced for physical property testing. Details of many of these tests were reported in the Interim Report although only a few of the variable parameters had been investigated at that time. Upon receipt of further test information, a complete compilation of results will be made and furnished in one of the subsequent reports.

Investigation of the various hardening agents for the copper baths has been accelerated and a number of successful electroformed samples produced. Results of the physical property tests of these materials have not yet been received.

A small amount of experimental work has been done on electroforming of other materials of a non-magnetic nature. A small six-inch diameter mirror was produced by the electro-deposition of brass. No physical property tests of this material have been made.

3. COATING STUDIES

Slight warpage was found in a number of the reflectivity samples. This warpage caused variations in reflectivity readings. In order to provide samples which could be closely compared for reflectivity values, before and after testing, new samples have been produced to the necessary degree of flatness. Reflectivity measurements are being made on these new samples.

Work has been re-emphazied on pre-deposited coatings. A number of five-inch diameter flats have been coated with various combinations of vacuum deposited reflective and protective surface coatings. The success of the subsequent plating operation appears to be directly dependent on the quality and reproducibility of the original vacuum deposited coatings. The greatest problems appear to be due to pin holes or leakage occurring between master and reflective coatings of low adhesion levels. A gasket or edge-seal technique has been used to minimize edge leakage, and a number of satisfactory parts have been electroformed and parted. After removal of the copper parting layer, the mirrors were examined and found to be of relatively high quality from an appearance stand point. Reflectivity measurements will be made on these mirrors in the near future.

4. FUTURE EFFORTS

During the next reporting period, work will continue or be undertaken in the following areas:

1. Small scale plating and developmental studies will be undertaken as required on torus supported or on segmented preassembled units.
2. Fabrication will continue on the remaining parts for the rotational fixture. Additional special tooling required for fabrication of the five-foot diameter unit will be produced as the specific requirements become known. Work will continue on the preliminary models of the five-foot diameter concentrators and will include attachment to the face skins of the rigidizing tori. Techniques and tooling required for the formation of the structural bridge between torus and reflective skin will be developed. Fabrication of additional torus mounts and transition sections and at least one all electroformed nickel torus is expected to be completed.
3. Plating studies will continue with emphasis on further investigation of the various parameters of the nickel baths and development of controls for the modified copper solutions. Physical property tests will continue.
4. Further attention will be given to multiple coatings prior to electroforming and an effort will be made to determine the factors that cause failure so these can be corrected when applied to larger units. An effort will be made to apply reflectivity increasing dielectric overcoatings on small samples. An evaluation will be made with a varity of various reflectivity coatings.